

05 - Telescope Optics Project

Part C -- Limiting Visual Magnitude

Get comfortable, flashlights off, take that glint out of your eyes and get them dark adapted! For your unaided eye observations, you will identify stars from The Trained Sky Star Atlas and find the faintest star you can see in a constellation. Once you can identify the brighter stars in a constellation, you can use the patterns of stars on The Trained Sky Star Atlas to identify fainter stars and know where to look for them. If you see it, then try again with an even fainter star. You will perform this experiment for a constellation high overhead and one low on the horizon.

For your telescopic assisted eyes, you will work with stars in a cluster in much the same way. You will point the telescope towards either the Pleiades star cluster. The Pleiades is in Taurus. Look up its right ascension and declination in The Trained Eye Star Atlas. You will use the cluster you selected to determine the limiting magnitudes of your finder scope and the telescope for several different eyepieces.

1) Unaided Eye

You have a finding chart for an overhead constellation, and a near the horizon constellation. On the finding chart is a check list of stars to look for.

A) Check off all the stars you can see for the overhead constellation. Copy the information for the last star you check off into table 2.

B) Check off all the stars you can see for the near the horizon constellation. Copy the information for the last star you check off into table 2.

Table 2 Limiting Visual Magnitudes for Uaided Eye

Star Name	Limiting Magnitude	Altitude °	Azimuth °

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2) Finder Telescope

Your instructor will assign 1 of the 3 star clusters in Table 3. Estimate the limiting magnitude by just counting how many stars you see in the cluster. Count only those stars in the inner half of the finder field (inner 2 degrees). If you count five stars then you are seeing just the five brightest stars in the cluster, so count down 5 stars on the following list and that is your limiting visual magnitude. Record that limiting visual magnitude in Table 5 for the Finder.

Table 3: Stars From Brightest to Faintest

Pleiades	
1	2.87
2	3.64
3	3.71
4	3.88
5	4.18
6	4.31
7	5.09
8	5.45
9	5.64
10	5.76
11	6.17
12	6.29
12	6.43
14	6.60
15	6.74
16	6.81
17	6.82
18	6.93
19	6.85
20	6.95
21	6.99
22	7.18
23	7.26
24	7.35
25	7.52
26	7.54
27	7.66
28	7.77
29	7.85
30	7.90
31	8.04
32	8.06
33	8.10
34	8.11
35	8.17
36	8.23
37	8.27
38	8.28
39	8.37
40	8.37
41	8.58
42	8.60
43	8.69
44	8.95
45	8.95

M 39	
1	6.58
2	6.63
3	7.66
4	8.21
5	8.76
6	8.92
7	9.00
8	9.05
9	9.44
10	9.63
11	9.67
12	9.81
13	10.8

Praesepe	
1	6.39
2	6.59
3	6.67
4	6.73
5	7.75
6	6.78
7	6.85
8	6.90
9	7.32
10	7.37
11	7.73
12	7.80
12	7.83
14	7.96
15	8.14
16	8.25
17	8.33
18	8.48
19	8.5
20	8.5
21	8.53
22	8.65
23	8.71
24	8.89
25	9.00

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3) Main Telescope

Your instructor will assign 1 of the 3 star clusters in Table 4.

A) Using the main telescope, you can identify individual stars. Start with the low-power eyepiece. Try to identify the first star in Table 4 through the eyepiece using the finding chart. Check it off in table 4 if you can see it. Repeat this process for the medium-, and high-power eyepieces.

B) Repeat this for each star on down the list until you reach a star that you can't find through any of the eyepieces.

C) Copy the magnitude of the last star you saw for each eyepiece into Table 5.

Hint: Notice how dark the sky looks through each eyepiece and how well the stars stood out.

Table 4 Visual Magnitudes for Pleiades Star to be Identified

Visual Magnitude	Low Power (mm)	Medium Power (mm)	High Power (mm)
3.9			
4.3			
5.5			
5.8			
6.4			
7.2			
8.6			
10.6			
11.3			
11.7			
12.7			
13.6			

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Table 4 Visual Magnitudes for M39 Star to be Identified

Visual Magnitude	Low Power (mm)	Medium Power (mm)	High Power (mm)
6.5			
7.7			
8.2			
9.0			
9.6			
9.7			
10.8			
11.3			
12.1			
12.6			
12.9			

Table 4 Visual Magnitudes for Praesepe Star to be Identified

Visual Magnitude	Low Power (mm)	Medium Power (mm)	High Power (mm)
6.4			
7.7			
8.1			
8.9			
9.2			
9.7			
10.1			
10.3			
10.8			
11.5			
12.2			
12.7			

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Table 5 Limiting Magnitudes for Telescopes

Optical Device	Limiting Magnitude
Finder Scope	
Low Power (mm)	
Med Power (mm)	
High Power (mm)	

Questions

10) Using your results in Table 2, how many magnitudes fainter can you see overhead than near the horizon with the unaided eye?

	Star Name	Magnitude
Overhead		
Near Horizon		
Magnitude Difference		

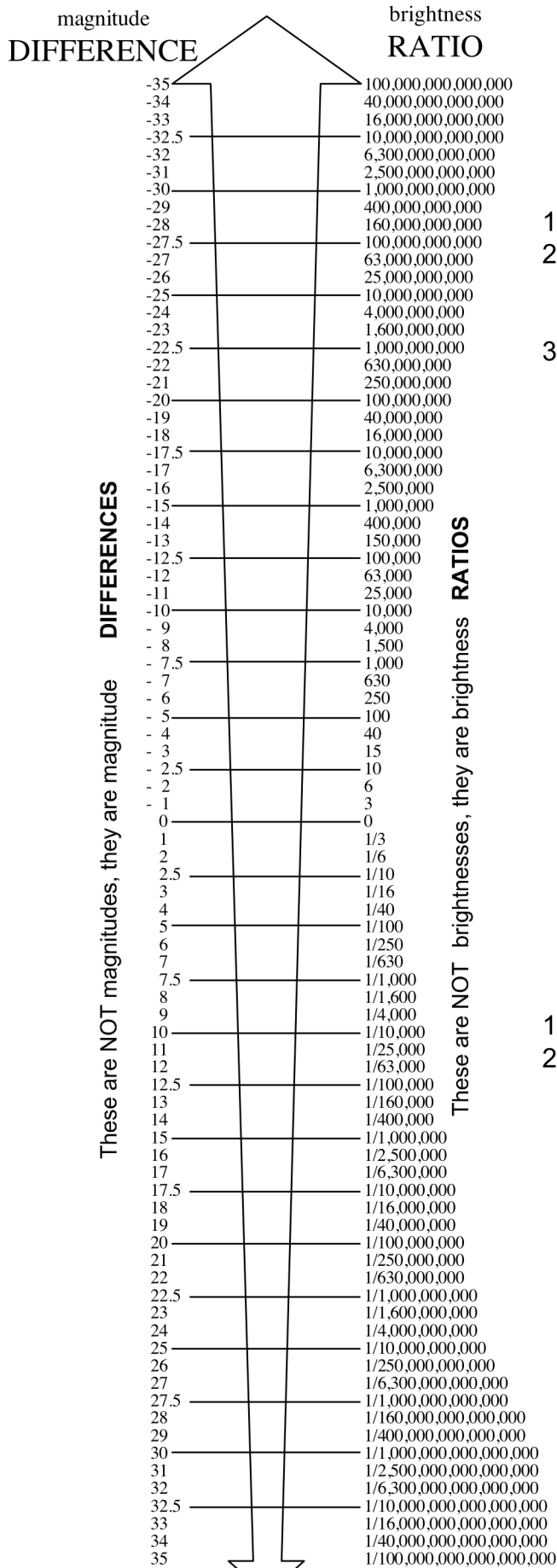
11) How many times fainter are you seeing overhead than near the horizon? _____

Hint: Use the md to br chart on the next page to convert the magnitude difference between the two stars in Question 10 to a brightness ratio.

12) Why can you see fainter stars overhead than near the horizon? Give at least 3 reasons.

<p>Answer:</p> <p>1)</p> <hr/> <hr/> <hr/> <p>2)</p> <hr/> <hr/> <hr/> <p>3)</p> <hr/> <hr/> <hr/>

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How to convert a magnitude difference to a brightness ratio

- 1) You need magnitudes for 2 (TWO) stars
- 2) Subtract the magnitude of the second star from the first star to get the magnitude difference.
- 3) Find the magnitude difference on the left side, and read straight across to the corresponding brightness ratio

For Example....

Star A = magnitude is +8
 Star B = magnitude is +13

subtract +13 from +8
 magnitude difference is **-5**

find **-5** on the left side and read straight across to the corresponding brightness ratio of 100

Star A is **100 times** brighter than star B

How to convert a brightness ratio to a magnitude difference

- 1) You need a brightness ratio for 2 (TWO) stars
- 2) Find the brightness ratio on the right side, and read straight across to the corresponding magnitude difference

For Example....

Star A is 10 times brighter than star B

find **10** on the right side and read straight across to the corresponding magnitude difference of **-2.5**

Star A is **-2.5 magnitudes** brighter than star B

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13) Using your results in Table 2 and Table 5, how many magnitudes fainter can you see with the finder telescope than with the unaided eye overhead?

	Star Name	Magnitude
Finder		
Overhead Eye		
Magnitude Difference		

14) How many times fainter are you seeing with the finder than with the unaided eye?

Hint: Use the md to br chart on the next page to convert the magnitude difference between the two stars in Question 10 to a brightness ratio.

15) Using your results in Table 2 and Table 5, how many magnitudes fainter can you see with the finder telescope than with the unaided eye overhead?

	Star Name	Magnitude
Main Scope		
Overhead Eye		
Magnitude Difference		

16) How many times fainter are you seeing with the main telescope than with the unaided eye? _____

Hint: Use the md to br chart on the next page to convert the magnitude difference between the two stars in Question 10 to a brightness ratio.

17) Using your results in Table 5, how many magnitudes fainter can you see with the main telescope than with the finder telescope?

	Star Name	Magnitude
Main Scope		
Finder Scope		
Magnitude Difference		

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18) How many times fainter are you seeing with the main telescope than with the finder telescope? _____

Hint: Use the md to br chart on the next page to convert the magnitude difference between the two stars in Question 10 to a brightness ratio.

19) Contrast in the table below your limiting magnitudes for your eye (Table 2), finder telescope (Table 5) and main telescope (Table 5) with the limiting magnitudes for various apertures (Table 3-1 on page 1).

	Me	theory
Unaided eye		
Finder scope		
Main scope		

20) Explain why your results differ. Give at least 3 reasons.

<i>Answer:</i>
1)
2)
3)

21) What happens to the brightness of the sky as you switch to higher and higher power eyepieces? Did it get brighter or darker, as you switched to higher power eyepieces? Describe.

<i>Answer</i>

22) For your main telescope, did you see fainter with higher power or lower power eyepieces?

Hint: Your answer to question 21 might have something to do with it.

<i>Answer</i>